

REMARKS

Applicant thanks the Examiner for considering the references cited with the Information Disclosure Statement filed April 19, 2002.

Applicant thanks the Examiner for withdrawing the rejections of claims 1, 2, 7-11 and 25 set forth in the March 3, 2002 Office Action.

Status of the Application

Claims 1, 2, 4, 5, 7-11 and 25-33 are all the claims pending in the Application. Claims 1, 2, 4, 5, 7-11 and 25-33 have been rejected.

Indefiniteness Rejection of Claims 10 and 31 Under 35 U.S.C. § 112, Second Paragraph

The Examiner has rejected claims 10 and 31 as being indefinite under 35 U.S.C. § 112, second paragraph. The informalities noted by the Examiner have been corrected. Thus, withdrawal of this rejection is respectfully requested.

Obviousness Rejections of Claims 1, 2, 4, 5, 7, 8, 9, 25-30 and 33 Under 35 U.S.C. § 103(a)

The Examiner has rejected claim 1, 2, 4, 5, 7, 8, 9, 25-30 and 33 under 35 U.S.C. § 103(a) as being unpatentable over Mizushima (JP 05-090262; hereinafter "Mizushima") in view of Farkas (US 6,001,730; hereinafter "Farkas"). This rejection is respectfully traversed.

Mizushima

Mizushima discloses a semiconductor device consisting of substrate 1, 1st insulator layer 7, conductor 14 and insulation film 15. Conductor 14 is surrounded on the sides and bottom by 2nd electric conduction film 11, made of an alloy of titanium or titanium and tungsten. Sidewall

insulating film 13 is provided between conductor 14 and 2nd electric conduction film 11 on the sides of conductor 14 only.

Farkas

Farkas discloses a semiconductor device consisting of (see FIG. 2) a substrate 12, dielectric/etch stop layers 16, 18 and 20, and conductive copper layer 22. A tantalum-based barrier layer 21 is provided on the sides and bottom of conductive copper layer 22, and is formed of one or more of tantalum, tantalum nitride (TaN), tantalum silicon nitride (TaSiN), or composites thereof (see col. 4, lines 52-54).

The Examiner's Position

The Examiner takes the position that Mizushima discloses most of the basic structure recited in independent claims 1 and 4, *i.e.*, a substrate (1), dielectric (7), wiring line (14), first cover layer (11) and third cover layer (dielectric) (13).

However, the Examiner concedes that Mizushima does not disclose that: the conductor is made of copper; the “first cover layer” is “made of refractory metal nitride;” a “second cover layer [is] provided between the conductor and the first cover layer;” or the “second cover layer” is made of “refractory metal.”

In an attempt to disclose such features, the Examiner then applies Farkas, taking the position that Farkas discloses “the use of Cu conductor 28 and a diffusion layer for Cu could be a combination of layers of Ta, TaN, TaSiN... etc. (see col. 4, lines 45-58).” The Examiner proffers that a “person of ordinary skill” would have been “motivated to modify Mizushima with Farkas for better protection against diffusion of Cu.

Thus, as Applicant understands it, the Examiner is arguing that the listed alternative constructions of barrier layer 21 (“one or more of tantalum, tantalum nitride, tantalum silicon nitride or composites thereof”) could somehow disclose a two-layer construction recited in claim 1, *i.e.*, both the “first cover layer” and the “second cover layer.”

Applicant's Position A - There is No Motivation to Combine

Applicants respectfully submit that there would have been no motivation to modify Mizushima in view of Farkas, and that the proffered reason, *i.e.*, “for better protection against diffusion of Cu,” is unsupported by the references.

Specifically, Mizushima is directed to providing a structure for use with a gold conductor 14 (see prg. 0013). Mizushima does not disclose the use of a copper conductor, and thus cannot provide any specific motivation to add any barrier layers that are disclosed as being for use with copper conductors (such as layer 21 in Farkas).

Further, Farkas is specifically directed towards providing a structure “for copper interconnects” and the utilization of Ta-based alloys for a barrier layer (see col. 1, lines 9-10) in combination with that copper layer. Farkas provides no teaching or suggestion that barrier layer 21 could be applied to a gold conductor, nor any teaching that a copper conductor would or could replace the gold conductor disclosed in Mizushima.

Lastly, even if motivation to replace gold conductor Mizushima with the copper conductor Farkas could be found, Applicants respectfully submit that there would still be no motivation to include dielectric layer 13 of Mizushima (cited by the Examiner as disclosing the third cover layer) with the resultant structure. There is no teaching or suggestion that this

dielectric layer 13 would have any use between the copper conductor and barrier layer of Farkas. The Examiner has simply not explained why one of skill would not have merely replaced the gold conductor 14, conductive film 11 and insulating film 13 of Mizushima with the copper conductor 22 and barrier layer 21 of Farkas.

Thus, Applicant respectfully submits that the Examiner has not provided the required motivation to modify Mizushima with Farkas, and therefore has not established *prima facie* obviousness.

Applicant's Position B - No Combination Discloses All Claimed Features

Even if some motivation to modify Mizushima with Farkas can somehow be identified, Applicant respectfully submits that even the resultant combination would fail to teach or suggest all of the features recited in claim 1.

In contrast to the Examiner's position that "a diffusion layer for Cu could be a combination of layers of Ta, TaN, TaSiN," Applicant respectfully submits that Farkas merely discloses alternative constructions for use in barrier layer 21, rather than any specific order of separate layers within barrier layer 21. Specifically, col. 4, lines 49-54, state that:

the tantalum-based barrier layer 21 is formed within the trench/interconnect opening in layer 20, within the via opening in layer 16, and over a top surface of the layer 20. The tantalum-based barrier layer is one or more of tantalum, tantalum nitride (TaN), tantalum silicon nitride (TaSiN), composites thereof or the like in a preferred form.

Applicant respectfully submits that this portion of Farkas only contemplates barrier layer 21 as being a single integral layer, albeit one which could be made up of different combinations

or mixtures of the listed materials. Applicants respectfully submit that Farkas is simply silent on the provision of any individual layers composed of different materials within barrier layer 21, and thus cannot teach or suggest such separate, discrete layers.

Further, even if the mention of “composites” in the above section of Farkas could somehow be read as disclosing that barrier layer 21 *is* made up of multiple layers, Applicant respectfully submits that Farkas is completely silent regarding any order of any layers that would make up the disclosed “composites.” Thus, Farkas simply cannot be read as teaching or suggesting the specific arrangement recited in claim 1, *i.e.*, a refractory metal inner layer and a refractory metal nitride outer layer.

Additionally, Applicant respectfully submits that the cited section is no more than a bare invitation to experiment, *i.e.*, only “obvious to try,” which has long been held as being insufficient to support *prima facie* obviousness. More specifically, Applicant submits that the Examiner merely proffers that one of skill would have been motivated “to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result,” *i.e.*, Farkas’ various disclosed materials. However, Applicant submits that the “prior art gave either no indication of which parameters were critical or no direction as to which of many possible choices is likely to be successful,” *i.e.*, both references are silent regarding any benefit of any specific order of any “composite.” See *In re O'Farrell*, 853 F.2d 894, 903, 7 USPQ2d 1673, 1681 (Fed. Cir. 1988).

Thus, for *at least* the reasons cited above, Applicant respectfully submits that the proffered combination cannot teach or suggest both a “first cover layer” and a “second cover layer provided between the conductor and the first cover layer,” as recited in claim 1.

Thus, Applicants respectfully request that the Examiner withdraw this rejection.

Additionally, Applicant respectfully submits that claims 2, 5, 7-11 and 25-33, which are dependent from independent claims 1 and 4, are allowable, *at least* by virtue of that dependency.

Obviousness Rejections of Claims 10 and 31 Under 35 U.S.C. § 103(a)

The Examiner has rejected claim 10 and 31 under 35 U.S.C. § 103(a) as being unpatentable over Mizushima in view of Farkas and further in view of Mori et al. (US 6,303,495; hereinafter “Mori”). This rejection is respectfully traversed.

The Examiner has taken the position that any proposed combination of Mizushima and Farkas would fail to teach or suggest that both “a bottom surface of the first cover layer is approximately in a same level as an upper surface of the first dielectric layer,” and that “a top surface of the first cover layer is approximately in a same level as an upper surface of the second dielectric layer.”

In an attempt to provide a reference that teaches or suggests such features, the Examiner has applied Mori, taking the position that FIG. 9 discloses the recited structure, at least in the stacked relationship between interlayer insulation film 18a, TiN film 19a and interlayer insulation film 18b.

However, Applicant respectfully submits that “etch stop layers” are not disclosed in Mori, and are clearly not shown in FIG. 9. Further, although the Examiner has cited elements 18a, 18b and 19a of FIG. 9 as disclosing the features recited in claims 10 and 31, the Examiner has not explained how these cited elements correspond to the claimed features.

Thus, Applicant is left to guess as to the Examiner’s intention, and such ambiguity cannot support *prima facie* obviousness.

Further, although not expressly stated, Applicant assumes that the Examiner intends to identify insulation film 18a as the recited “first dielectric layer,” insulation film 18b as the “etch stop layer,” and insulation film 18c as “second dielectric layer formed on the etch stop layer.”

However, such a construction clearly does not teach or suggest the features recited in claims 10 and 31, as the top surface of TiN film 19a is not “approximately in a same level as an upper surface of the second dielectric layer. Rather, the top surface of TiN film 19a would be at the bottom surface of the second dielectric layer.

Thus, as the proffered combination of references does not teach or suggest all of the features of the rejected claims, Applicant respectfully requests that the Examiner withdraw this rejection.

Obviousness Rejections of Claims 11 and 32 Under 35 U.S.C. § 103(a)

The Examiner has rejected claim 11 and 32 under 35 U.S.C. § 103(a) as being unpatentable over Mizushima in view of Farkas and further in view of Nogami et al. (US 6,214,731; hereinafter “Nogami”).

Applicant respectfully submits that claims 11 and 32 are allowable, at least by virtue of their dependency from claims 1 and 4, respectively.

Thus, Applicants respectfully request that the Examiner withdraw this rejection.

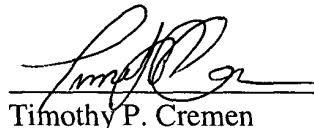
Conclusion

In view of the foregoing, it is respectfully submitted that claims 1, 2, 4, 5, 7-11 and 25-33 are allowable. Thus, it is respectfully submitted that the application now is in condition for allowance with all of the claims 1, 2, 4, 5, 7-11 and 25-33.

If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

Please charge any fees which may be required to maintain the pendency of this application, except for the Issue Fee, to our Deposit Account No. 19-4880.

Respectfully submitted,



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Date: March 3, 2003

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

The claims are amended as follows:

10. (Amended) The device according to claim 1, wherein the dielectric in which the wiring line is buried has a composite structure comprising a first dielectric layer, an etch stop layer formed on the first dielectric layer, and a second dielectric layer formed on the etch stop layer;

and wherein [the] a bottom surface of the first cover layer is approximately in a same level as an upper surface of the first dielectric layer;

and wherein [the] a top surface of the first cover layer is approximately in a same level as an upper surface of the second dielectric layer.

31. (Amended) The device according to claim 4, wherein the dielectric in which the wiring line is buried has a composite structure comprising a first dielectric layer, an etch stop layer formed on the first dielectric layer, and a second dielectric layer formed on the etch stop layer;

and wherein [the] a bottom surface of the first cover layer is approximately in a same level as an upper surface of the first dielectric layer;

and wherein [the] a top surface of the first cover layer is approximately in a same level as
an upper surface of the second dielectric layer.